# THE EARLY STAGES OF *ACTINA INCISURALIS* [DIPTERA, STRATIOMYIIDAE].

By Mary E. Fuller, B.Sc.,
Assistant Research Officer, Council for Scientific and Industrial Research, Canberra, F.C.T.

(Nine Text-figures.)

[Read 25th July, 1934.]

## *Introduction.*

The first reference in Australian literature to *Actina incisuralis* Macq. was by White (1914), when he described both sexes and gave the distribution of the species as Tasmania, Victoria and N. S. Wales. Two years later (White, 1916) he stated that *A. incisuralis* ranges from Tasmania to Queensland and is one of the commonest and most widely distributed of Australian Stratiomyiidae. Hardy (1931) described three new species of *Actina* and pointed out the variability in coloration of *A. incisuralis*.

This species belongs to the subfamily Beridinae, to which the larvae described in the present paper also run in Malloch's key to Dipterous larvae (1917). The adults bred from the same series have the normal coloration and agree with the descriptions of typical *A. incisuralis*.

The work of White and of Hardy is purely taxonomic. The only published work on the early stages of Australian Stratiomyiidae is that of Irwin-Smith (1920-23) on *Metoponia rubriceps* Macq., a brief note by J. G. Myers (1920) on *Neoexaireta spiniger* Sch., and a short description by Froggatt (1896) of a species of *Ophiodesma* from grass-tree. Nothing has been written on the life-histories of Australian species of *Actina*.

## *Observations on Habits of Larvae.*

During the course of carrion insect investigations in August, 1932, larvae of *Actina incisuralis* were found in abundance on the under-surface of a sheep carcase, which had been lying in the same place for seven months. Larvae of all sizes were numerous on the moist, slimy surface of the bones, and, when disturbed, moved slowly away into crevices. They were also present in large numbers amongst the wet wool, and on the remains of the skin.

The following month, when searching for earthworms, quantities of *A. incisuralis* larvae were found on the earth under masses of rotting grass. They were also present in the soil amongst the roots of growing grasses and at the bases of the stems. In all these situations moisture was plentiful. Apparently the food of these larvae is not specific, as they are found associated with decaying plant and animal matter as well as with living plants, but moisture seems to be essential.

Larvae from the carcase and from grass were placed in two separate jars provided with damp soil and wool or grass. Nothing was added to the jars except a little water from time to time. The larvae did not appear to grow after being placed in the jars but many pupated. There was no change in external appearance, the larva simply becoming immobile and the skin hardening. After a period of from 7 to 8 months from the time of collecting, adults of *A. incisuralis* emerged in numbers from both jars.

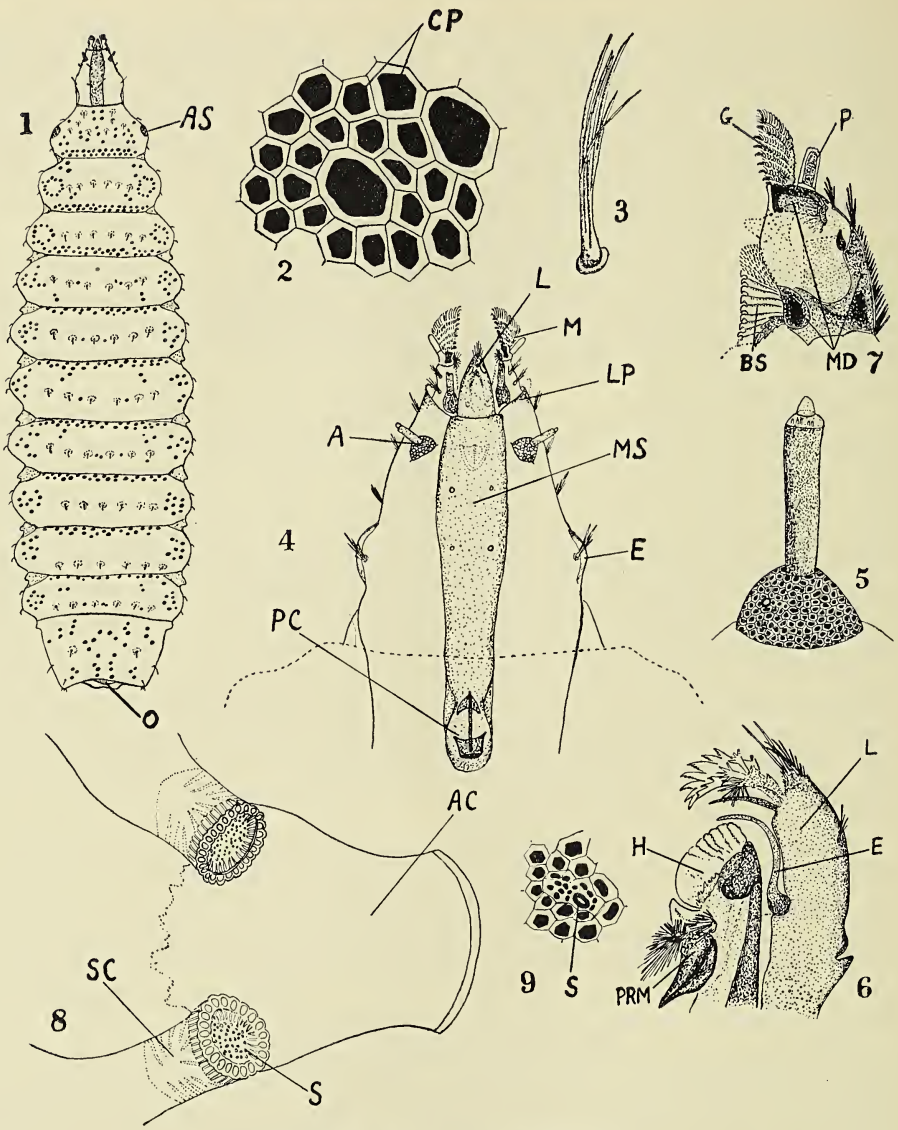
*Description of Larva.*

The length of the larvae taken in the field varied from 4 to 9 mm. They were evidently full-grown at 9 mm., as all of that size pupated and the flies that emerged were of the same size as captured specimens. The colour changed with age, the smaller larvae being a dirty whitish shade, becoming greyish-brown and finally brown.

The body (Text-fig. 1) is somewhat flattened dorso-ventrally, although the younger larvae are more cylindrical in form. The dorsal and ventral surfaces are convex and the lateral edges produced into a ridge. In the younger larvae the arrangement of body bristles and structure of the head and mouth parts seem to be similar to that of the mature larvae. It was not determined when or how often ecdysis takes place. There are eleven body segments and a head. The body is strongly constricted between the segments, giving the larva a scalloped appearance along the sides. Dorso-laterally the integument between each abdominal segment, and between the third thoracic and first abdominal, is produced into a small papilla projecting outwards. The thoracic segments become broader passing from the head, whilst the abdominal segments are of uniform width and length, with the exception of the eighth, which is narrower and longer than the others, more flattened and produced into two blunt projections at the posterior corners. All the body segments are much broader than long. The head is elongated, narrow and pointed.

The larva is lighter in colour on the ventral surface. The colour is due to the presence of a close armour of small, hexagonal plates which occur all over the surface (Text-fig. 2). These vary from light to dark brown, causing the difference in colour on the two surfaces and in young and old larvae. On the lateral edges also the skin is lighter in colour. The plates are calcareous, and the skin bubbles freely when hydrochloric acid is applied, a test suggested by Lundbeck (1907). Certain of the plates are much enlarged, more roughly circular in outline and more densely coloured, standing out as conspicuous spots. These spots are arranged in a definite pattern. Both dorsally and ventrally there is a double row at the junction of each segment, except at the fore border of the first thoracic, and dorsally between the seventh and eighth abdominal segments, where there is only a single row. A group occurs on both surfaces near the lateral edges of each segment, arranged in the segments nearer the head in a rough circle. There are a few other spots scattered about on the dorsal surface, being most numerous on the first and last segments (Text-fig. 1).

Bristles and hairs are present on the body and are arranged as follows: On the dorsal surface of each segment, except the last, near the middle are six lighter coloured areas where the hexagonal plates are smaller and less pigmented. These occur in a row across the segment three each side of the centre except on the first segment where they form two triangular groups. From each of these areas




Text-figs. 1-9. *Actina incisuralis.*

1.—Full-grown larva. × 7·5. *as*, anterior spiracle; *o*, opening of air chamber.
2.—Larval integument. × 280. *cp*, calcareous plates.
3.—Branched dorsal bristle. × 190.
4.—Head of larva viewed dorsally. × 45. *a*, antenna; *e*, eye rudiment; *l*, labrum; *lp*, lateral plate; *m*, maxilla; *ms*, median sclerite; *pc*, pharyngeal chamber.
5.—Antenna. × 190.
6.—Labrum and hypopharynx. × 100. *e*, epipharynx; *h*, hypopharynx; *l*, labrum; *prm*, prementum.
7.—Maxilla, inner surface. × 100. *bs*, banded segment; *g*, galea; *md*, mandible; *p*, palp.
8.—Posterior spiracles. × 180. *ac*, air chamber; *s*, spiracle; *sc*, sieve chamber.
9.—Abdominal spiracle. × 280. *s*, spiracle.

arises a large branched bristle accompanied by a number of smaller ones (Text-fig. 3). These bristles are blunt and curved at the upper extremity. They project straight up and then bend slightly in towards the centre; they are a pale yellow colour. In many individuals the bristles curve posteriorly instead of medially. On the last segment there are only two of these groups of bristles, one each side of the middle. The first segment has some extra bristles on the dorsal surface anteriorly.

On the lateral edges of each segment are two pairs of blunt bristles curved backwards, one pair being dorsal and one ventral. The more posterior member of each pair is larger than the other. On the last segment there is only one bristle laterally and a tuft on the dorsal and ventral surfaces of the projections at the posterior corners. On the ventral surface, across each segment is a wide band of fine colourless hairs curved backwards. This band does not extend to the lateral edges of the segment but occupies the central third only. The hairs are numerous and closely set. On the last segment they surround the anal groove.

On the ventral surface of the eighth segment, there is a short transverse fold in the skin near the anterior border of the segment. At right angles to this fold and running from it longitudinally down the middle of the segment a little more than half-way to the posterior edge is the anal slit. The lips are armed on the inner edge with a series of strong, inwardly and backwardly directed teeth which interlock when the slit is closed. The rest of each lip is covered with fine hairs directed in the same way. From the end of the anal slit to the posterior border of the segment is a deep narrow groove. There is also a postero-dorsal groove on the last segment running transversely and protecting the opening to the air cavity into which the posterior spiracles open.

*The Head* (Text-fig. 4).—The head is elongated and somewhat conical in shape. On the dorsal surface there is a strongly chitinized brown sclerite running down the centre for the whole length, being a little less than a third the width of the head. This is constricted towards the anterior end and then slopes to a point forming the labrum. The rest of the integument of the head is thinner and pale yellow in colour. The "lateral plates" of Irwin-Smith occur each side of the labrum near its base and articulate with the maxillae. The maxillae lie slightly below and on each side of the labrum, in front of which they extend. They are complicated in structure. The antennae (Text-fig. 5) are situated a short distance behind the junction of the maxillae with the side lobes, occupying a dorsal position close to, and on each side of, the middle sclerite. Each consists of a large mound-like basal segment, closely covered with small brown plates which are darker and more conspicuous than those on the rest of the head. On the inner side half-way to the apex is one bristle. From the apex of the basal segment arises an elongated strongly chitinized stout segment, whilst the apical segment is small and dome-shaped. The antennae are large and conspicuous features of the head.

A little behind the middle of the head are a pair of lateral swellings representing rudimentary eyes. On the dorsal surface, and near the outer edge of each eye-swelling, there is a small concavity from which a branched hair with a large swollen base arises. Two other branched hairs arising from small depressions occur on each side of the head between the eye rudiment and the maxilla. On the median dorsal sclerite are a number of bristles arranged in two rows down the sides.

*Mouth Parts.*—A lateral view of the head shows the labrum arising from the dorsal sclerite and curving between the two maxillae, so that its plume-like appendage is ventral. The maxillae lie each side of the labrum and their palps and spinose galeas are the most anterior of the mouth parts. The mandibles are fused to the inner faces of the maxillae. The hypopharynx is close against the ventral face of the labrum. The labium is situated behind and below all these parts. It consists of a small prementum in the form of a spade-shaped chitinous sclerite attached to the ventral face of the hypopharynx near its base and covered with tufts of hairs and spines, a mentum made up of two lobes of thin membranous chitin densely covered with fine hairs, and a submentum consisting of a hairy membranous plate and a turned back part of very delicate chitin with long fine hairs on its edge. The mentum overlies ventrally the basal half of the maxillae.

The side-lobes of the head, called by Irwin-Smith "lateral plates", and by Bischoff (1925) "lateralia", are not pointed at the apex as in *Beris* and *Metoponia*, but are truncated or blunt, and project forwards over the base of the maxillae; that is, the maxillae arise from the head at a point before the termination of the lateral lobes and are sheathed by them at the sides. The mentum is joined to the lower edges of the lateral lobes and passes across the ventral surface of the head forming a lower lip.

The labrum (Text-fig. 6) consists of a strong boat-shaped sclerite, being the apical termination of the dorsal head plate. It narrows at the apex and is curved towards the ventral surface. At the apex is a tuft of spines, among which are two longer ones. Below and behind this is a large plumose structure strongly recurved ventrally. It is trifid, having a large central, and two smaller side lobes. Each lobe is doubly serrated, and the whole is of delicate membranous chitin. Closely associated with this structure is a chitinous rod, which arises a little behind it. Behind this there is a wide slit along the ventral surface, where the lower edges of the boat-shaped sclerite do not meet. This open part is protected by a strong chitinous structure, which is connected at its base with the postero-ventral edge of the labrum and extends forward lying along the ventral surface as a curved chitinous plate. Its position indicates that it represents the epipharynx. The hypopharynx lies below the labrum against the epipharynx, and consists of a sclerite with a chitinous strut along its inner edge and a curved dissected apical end. The prementum is attached on the ventral surface and behind the curved apex, so that the hypopharynx lies between the labrum and labium.

The maxilla (Text-fig. 7) is very complex in structure, having the mandible fused with its inner face. It is slightly convex on the outer surface, from which two large plumose hairs arise towards the top edge. Also on the outer surface, just behind the palp, is a chitinous knob bearing a tuft of spines spreading fan-wise. The palp arises from the outer surface just behind the apex, which is occupied by the galea, a fan-shaped structure bearing rows or combs of fine, closely set hairs, hooked at the ends. The dorsal edge of the maxilla is fringed with some rows of bristles directed forwards. The posterior half of the ventral edge is occupied by Bischoff's "banded segment" supplemented in front by a small area densely covered with hooked spines. The inner face of the maxilla shows the closely appressed mandible. Bischoff's terminology is being used for these

parts for the sake of uniformity and convenience, but without necessarily agreeing as to their homology. At the base of the mandible is a very densely chitinized mass lying just above the banded segment. It is rounded and narrows anteriorly. Above this is a more lightly chitinized band running up to the dorsal edge of the maxilla. It continues along the dorsal edge with stronger chitinization, and then becomes thin again just before the knob bearing the spreading spines, ending in a strong chitinous piece close to the apex of the maxilla at the base of the galea. In this feature it closely resembles many of the Stratiomyiid larvae illustrated by Bischoff.

The pharynx runs back to the middle of the first segment, and at its posterior end is a mechanism which, from the dorsal surface, has the appearance of a pump. There is a slight constriction in the wall of the pharynx at the anterior end of the structure and a bell-shaped mass fits into this narrow part. Below this is a broadly oval chamber which is filled by a piston-like mass of chitin, with a central rod connecting with the anterior portion. The posterior end of the chamber opens into the oesophagus. Viewed from the side the structure loses its piston-like appearance, and the central mass of chitin is seen to be composed of two parts, one forming the dorsal wall of the pharynx and curving towards the ventral side at the posterior end, the other a similarly curved piece lying parallel with it and connected with the part at the anterior end. The whole mechanism appears to be valvular in function and corresponds to Irwin-Smith's masticatory apparatus, the chitinous piston probably being her "wing-bearer".

*The Spiracles.*—On the dorsal surface of the eighth segment just before the posterior edge is a transverse fold, of which the ventral lip projects furthest. At the bottom of the fold centrally, there is an elliptical opening with strongly chitinized lips. On the inner edge of the lips are several bristles. The opening is the entrance to a large chamber, which extends back under the dorsal surface nearly as far as the posterior end of the anus (Text-fig. 8). The posterior spiracles are not visible externally, but open into this chamber near its base. In cleared specimens the spiracles may be seen through the skin. A large tracheal trunk runs into each side of the air cavity near its base and ends in a special modified section called by Irwin-Smith the "sieve chamber", in which a number of strong, short chitinous hairs project inwards from the wall. The sieve chamber ends in the spiracle, which opens into the air cavity. The spiracle is circular in outline, with a large opening in the middle surrounded by a thick raised rim, which is strengthened by a series of chitinous bars forming a ring-like pattern similar to the border of the slits in Calliphorid spiracles.

The anterior spiracles are situated on the prothorax laterally about the middle of the segment. They are larger than the posterior spiracles and consist of a mound of chitin raised above the surface of the integument. This is roughly circular in outline and is somewhat crater shaped, that is, the rim is raised and the centre sunken. Towards the anterior edge it is more elevated, and here the two spiracular slits open. They are oval and close together, but diverging at the top end. The chitinous mound slopes down from here to a roughened portion with a small gap, representing the stigmatic scar. The slits are the openings of the felt chamber, which is at the end of the tracheal trunk and lies inside the chitinous mound.

There is a pair of very minute spiracles present on the metathorax and on each of the abdominal segments except the last. They occur dorso-laterally and

appear as small black spots. Each lies between the two bristles on the lateral edges but nearer to the centre. The spiracle (Text-fig. 9) consists of an irregular opening surrounded by a strong chitinous rim projecting slightly above the surface. The surrounding area is composed of calcareous plates many times smaller than those of the general integument and more rounded in shape. There is one row of these small plates on the inside of the spiracle and several rows on the outer edge. No head spiracles were observed as noted in *Metoponia* by Irwin-Smith.

*The Puparium.*—Pupation takes place inside the old larval skin which, apart from becoming hard and rigid, does not change in appearance. When emergence of the fly occurs, the second segment splits right around in a circle near the anterior border, so that the whole of the first segment and head come off as a cap. A longitudinal split forms in the middle of the dorsal surface, extending from the free edge of the second segment to a point behind the anterior border of the fourth, where it meets another transverse split running right across the dorsal surface.

Just prior to emergence the chitin of the puparium becomes sufficiently transparent to show the outlines of the fly inside.

*References.*


Bischoff, W., 1925.—Ueber die Kopfbildung der Dipterenlarven. III. Teil. Die Kopfe der Orthorrhapha-Brachyceralarven. *Archiv. für Naturgeschichte,* Berlin, pp. 1-105.

Brauer, F., 1882.—Die Zweiflugler des Kais. Museums zu Wien. II. *Denkschr. k. Akad. Wiss. Wien,* xliv, p. 59.

————, Die Zweiflugler des Kais. Museums zu Wien. III. *Denkschr. k. Akad. Wiss. Wien,* xlvii, p. 1.

Froggatt, W. W., 1896.—The Entomology of the Grass-trees (*Xanthorrhoea*). Proc. Linn. Soc. N.S.W., xxi, 1, pp. 74-87.

Handlirsch, A., 1883.—Beitrage zur Biologie der Dipteren. *Verh. Zool.-Bot. Ges. Wien,* xxxiii, p. 243.

Hardy, G. H., 1920.—Australian Stratiomyiidae. *Proc. Roy. Soc. Tasmania,* p. 33.

————, 1932.—Australian Flies of Genus *Actina* (Stratiomyiidae). *Proc. Roy. Soc. Queensl.,* xliii, 10, pp. 50-55.

Irwin-Smith, V., 1920.—Studies in Life-Histories of Australian Diptera Brachycera. Part 1, Stratiomyiidae. No. 1. *Metoponia rubriceps* Macq. Proc. Linn. Soc. N.S.W., xlv, pp. 505-530.

————, 1921.—Ditto, No. 2. Further experiments in the rearing of *Metoponia rubriceps.* Proc. Linn. Soc. N.S.W., xlvi, pp. 252-255.

————, 1921.—Ditto, No. 3. On the structure of the mouth-parts and pharynx of the larval *Metoponia rubriceps.* Proc. Linn. Soc. N.S.W., xlvi, pp. 425-432.

————, 1923.—Ditto, No. 4. The respiratory system in larva, pupa and imago of *Metoponia rubriceps* Macq. Proc. Linn. Soc. N.S.W., xlviii, pp. 49-81.

Lundbeck, W., 1907.—Diptera Danica, Pt. 1. Stratiomyiidae, etc., Copenhagen. London, pp. 13-16.

Malloch, J. R., 1917.—A preliminary classification of Diptera, exclusive of Pupipara, based upon larval and pupal characters, with keys to imagines in certain families. *Bull. Illinois State Lab. Nat. Hist.,* xii, 3, pp. 161-407.

Myers, J. G., 1920.—Metamorphosis of the Fly *Exaireta spiniger* Sch. *N.Z. Journ. Sci. and Tech.,* iii, 2, p. 117.

White, A., 1914.—The Diptera-Brachycera of Tasmania. Part 1. Families Leptidae, Stratiomyiidae, Nemestrinidae and Cyrtidae. *Proc. Roy. Soc. Tasmania,* p. 50.

————, 1916.—A Revision of the Stratiomyiidae of Australia. Proc. Linn. Soc. N.S.W., xli, 1, p. 77.